

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**  
**BEFORE THE BOARD OF APPEALS AND INTERFERENCES**

Applicants : Beyong-Hwan RYU, et al.  
Serial No. : 10/551,484 (U.S. Patent Application Publication 2007-0160522)  
Filing Date : January 4, 2007  
For : METHOD OF PREPARING CARBON NANOTUBE FROM LIQUID  
PHASED CARBON SOURCE  
Examiner : Stuart L. HENDRICKSON  
Art Unit : 1793

745 Fifth Avenue  
New York, New York 10151

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**APPEAL BRIEF UNDER 37 C.F.R. 41.37**

**Mail Stop: Appeal Brief**  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

This Appeal Brief is filed in response to the final rejection of claim 1 and 3-11 in the Office Action mailed on 7 June 2010. A decision on the appellants' Request for Pre-Appeal Brief Review (filed on 7 September 2010) was mailed on 18 October 2010. Therefore, the date for filing the Appeal Brief without an extension of time cost was reset to 18 November 2010. The appellants petition for a one-month extension of time (\$130) which will be paid electronically (December 18<sup>th</sup> was a Saturday).

The Commissioner is authorized to charge any deficiency or credit any overpayment to Deposit Account No. 50-0320.

**(I) REAL PARTY IN INTEREST**

The real party in interest in this appeal is the assignee, Korea Research and Institute of Chemical Technology, who is the owner of this application by assignment from the inventor (Reel 018916/Frame 0400).

**(II) RELATED APPEALS AND INTERFERENCES**

Appellant is not aware of any related appeals or interferences which directly affect or are directly affected by or have bearing on the Board's decision in the pending appeal.

**(III) STATUS OF CLAIMS**

By the final rejection dated 7 June 2010, claims 1 and 3-11 have been finally rejected.

**(IV) STATUS OF AMENDMENTS**

No amendments were filed after the final rejection of 7 June 2010 and it is believed that all other amendments have been entered.

**(V) SUMMARY OF CLAIMED SUBJECT MATTER**

The only independent claim on appeal is claim 1 which reads as follows:

A method for preparing carbon nanotube from a liquid phased-carbon source, wherein the method uses a liquid phased-hydrocarbon based material as carbon source; and comprises the steps of

heating and pressurizing said carbon source to the range of critical temperature and critical pressure, and

reacting and cooling said carbon source in the presence of an autogenous seed catalyst which is a metal-containing acid salt wherein the acid is selected from the group consisting of acetic acid, hydrochloric acid, sulfuric acid and nitric acid to induce the growth of carbon nanotube.

Claim 1 under appeal is essentially the same as claim 1 as originally filed with the exception that the metal seed catalyst originally claimed is now an autogenous seed catalyst. Support for the claims as amended can be found throughout the specification, e.g. page 4, lines 6-11 and page 5, line 24 through page 6, line 2.

## **(VI) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

The appellants filed a Request for Pre-Appeal Brief Review (“the Request”) on 7 September 2010. A decision on the Request was mailed on 18 October 2010 and include a withdrawal of the rejection of claim 7 under 35 U.S.C. 112, first paragraph.

Therefore, the only remaining issue to be decided is the rejection of claims 1 and 3-11 under 35 U.S.C. 103(a) over Kawakami et al. (U.S. Patent 7,001,581 – “Kawakami”)

## **(VII) ARGUMENTS**

### **I. Legal Standards for Determining Obviousness in Light of *KSR v. Teleflex***

As reiterated by the Supreme Court in *KSR International Co. v. Teleflex Inc.* (*KSR*), 550 U.S. 398, 82 USPQ2d 1385 (2007), the framework for the objective analysis for determining obviousness under 35 U.S.C. 103 is stated in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966). Obviousness is a question of law based on underlying factual inquiries. The factual inquiries enunciated by the Court are as follows:

- (A) Determining the scope and contents of the prior art;
- (B) Ascertaining the differences between the prior art and the claims in issue;
- (C) Resolving the level of ordinary skill in the art; and
- (D) Evaluating evidence of secondary considerations.

When ascertaining the differences between the prior art and the claims in issue, both the claimed invention and the prior art are considered as a whole.

Once the *Graham* factual inquiries are resolved, Office personnel must determine whether the claimed invention would have been obvious to one of ordinary skill in the art.

### **II. Difference between the appellants’ claimed invention and Kawakami**

The appellants’ method clearly requires the use of an autogenous seed catalyst. However, there is no teaching from Kawakami for this element. The rejection refers to Kawakami, amongst its broad recitation of potential catalysts for their invention (see col. 9, line 39 thru col. 10, line 50 of Kawakami), as referring to certain types of acid salts (“While the reference does not teach the compounds enumerated, the teaching of acid salts and enumeration of formate and oxalate renders the claims obvious, since these are organic acid anions (like acetate)” – page 2, lines 8-11 of the final rejection).

However, this misinterprets the scope of catalysts used in the appellants’ claimed process, i.e. the appellants are not claiming all metal salts; the appellants are claiming a smaller group of

metal containing acid salts wherein the acid anion portion of the salt is derived from acetic acid, hydrochloric acid, sulfuric acid and nitric acid. From this limited group of metal containing acid salt catalysts, these catalysts *must then also possess the property* that it is also an autogenous seed catalyst, i.e. it is a seed catalyst which is spontaneously generated by controlling the heating rate and pressurizing the liquid phase hydrocarbon based material (see page 5, line 24 – page 6, line 4 of the appellants' specification). Kawakami never discloses that any of their catalysts has this property.

If the basis for the rejection was that there must be some metal salt from within the broad teachings of Kawakami which meets the appellants' limitation, Kawakami gives no guidance for this property of the catalyst. As cited in the recent "Examination Guidelines Update: Developments in the Obviousness Inquiry After KSR v. Teleflex" (Fed. Reg. 75, No. 169, Sept. 1, 2010), an obvious to try rationale may be proper when the possible options for solving a problem were known and finite. However, if the possible options were not either known or finite, then an obvious to try rationale cannot be used to support a conclusion of obviousness. See *Rolls Royce, PLC v. United Technologies Corp.*, 603 F.3d 1325 (Fed. Cir. 2010).

As applied here, the option of selecting an autogenous catalyst was not known or disclosed by Kawakami nor did the broad recitation of potential catalysts represent a finite number of solutions to their problem.

## **II. Consideration of Kawakami as a whole would have led one of ordinary skill in the art away from the appellants use of autogenous seed catalysts**

It is well known that "[i]f proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

When considering the teachings of Kawakami as a whole, it is clear that the methods for forming carbon nanotubes by Kawakami were more concerned about obtaining their nanotubes under low pressure conditions of less than 50 MPa and quantitatively producing nanotubes (see Abstract and col. 2, lines 49-58 of Kawakami); there was no suggestion or expectation of success that selecting an autogenous seed catalyst would have achieved Kawakami's desired properties.

Moreover, the carbon nanotubes produced by the process of the claimed invention have a diameter of 15-20 nm (see page 7, lines 13-16 of appellants' specification). Kawakami directs one of ordinary skill in the art to regulate the size of their carbon nanotubes by the size of the

catalyst particles used, not by the catalysts being autogenous seed catalysts (see col. 8, lines 49-61) which represents a further teaching away from the appellants' claim invention

For these reasons alone, Kawakami does not render obvious the appellants' claimed process for making carbon nanotubes from a liquid phased-carbon source which uses an autogenous seed catalyst.

**III. For claims 4, 9, 10 and 11, there is no recognition from within Kawakami that the variable to be optimized is a results-effective variable**

Claims 4, 9 and 10 (claim 11 is included because it includes the elements of claims 1, 5-8 and 10) were acknowledged to not explicitly teach the relative amounts and cooling rates, but was alleged to be a routine variation to one of ordinary skill in the art to optimize "reaction time and throughput for large scale processing" (see page 2, lines 11-12 of the final rejection).

First, the conditions alleged to be optimized do not address the elements acknowledged to be different or at least not explicitly taught.

Second, the allegation that it would have been routine to optimize condition (an *In re Aller*-type argument from MPEP 2144.05, **section II.A.**) requires first that "[a] particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977)." (see MPEP 2144.05, **section II.B.**). No such recognition was made in the rejection.

While claims 4, 9, 10 and 11 should be held to be unobvious for the reasons stated in section I. and II. above, the above arguments provides further evidence that claims 4, 9, 10 and 11 are unobvious over Kawakami.

The only comment in the final rejection with regard to the applicants' arguments and amendments filed on 8 April 2010 was that "[t]he argument about the catalyst overlooks the use

of organic acid salts, as noted above [While the reference does not teach the compounds enumerated, the teaching of acid salts and enumeration of formate and oxalate renders the claim obvious, since these are organic acid anions (like acetate)].”

However, Kawakami nor the state of the art neither teaches nor suggests that (1) the catalyst is an autogenous seed catalyst; or (2) that the catalyst is a metal containing acid salt where the acid is selected from the group consisting of acetic acid, hydrochloric acid, sulfuric acid and nitric acid.

The final rejection acknowledges that the recitation of formate and oxalate does not represent a teaching of the salts claimed by the applicants.

In addition, formate and oxalate cannot be considered to be obvious variants in light of the teaching of Kawakami as it is not even required that a salt of a transition metal be used in Kawakami’s process for making nanotubes (see col. 10, lines 9-14 which also refers broadly to metal sulfides, metal carbides, transition metal nitrides and transition metal oxides).

Even if one of ordinary skill in the art were to magically divine the specific salts used by the applicants from the broad teachings and virtually infinite number of possible catalysts referred to by Kawakami, there is still no teaching that this salt would be part of an autogenous seed catalyst which is defined by the applicants in page 5, line 13 – page 6, line 7 of the specification (or paragraph [0017] of the publication of this application) as being a seed catalyst which is spontaneously generated by controlling heating rate and pressurizing the liquid-phased hydrocarbon based material.

With regard to claims 4 (amount of hydrocarbon material and autogenous seed catalyst) and claims 9 and 10 (heating and cooling rate), it is alleged that these elements are obvious because “these are routine variations to one of ordinary skill to optimize reaction time and throughput for large-scale processing.”

However, MPEP 2144.05 section II.B. (Optimization of Ranges) states that “A particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977).” No such suggestion was made either in the Kawakami or the general state of the art.

For the above reasons, the obviousness rejection in view of Kawakami is in error and should be withdrawn.

**(VIII) CLAIMS APPENDIX**

1. (Previously presented) A method for preparing carbon nanotube from a liquid phased-carbon source, wherein the method uses a liquid phased-hydrocarbon based material as carbon source; and comprises the steps of  
heating and pressurizing said carbon source to the range of critical temperature and critical pressure, and  
reacting and cooling said carbon source in the presence of an autogenous seed catalyst which is a metal-containing acid salt wherein the acid is selected from the group consisting of acetic acid, hydrochloric acid, sulfuric acid and nitric acid to induce the growth of carbon nanotube.
2. (Canceled)
3. (Previously presented) The method of claim 1, wherein said metal is at least one selected from the group consisting of a transition metal; and a noble metal.
4. (Previously presented) The method of claim 1, wherein said hydrocarbon based material is used in the amount of from 80 to 99.999 wt%, while said autogenous seed catalyst is used in the amount of from 0.001 to 20 wt%.
5. (Original) The method of claim 1, wherein said hydrocarbon based material is at least one hydrocarbon selected from the group consisting of a saturated hydrocarbon, an unsaturated hydrocarbon, an aromatic hydrocarbon and a derivative thereof.
6. (Original) The method of claim 1, wherein said reaction temperature maintaining the critical state of said carbon source is ranging from 200 to 800 °C.
7. (Original) The method of claim 1, wherein said reaction pressure maintaining the critical state of carbon source is ranging from 1 to 400 atm.
8. (Original) The method of claim 1, wherein said critical state equilibrating between liquid



and gas phases is maintained for 1 min to 30 hrs.

9. (Original) The method of claim 1, wherein said heating and cooling rate are regulated within the range of from 0.01 to 50 °C/min.

10. (Original) The method of claim 9, wherein said heating rate is regulated within the range of from 1 to 30 °C/min, and said cooling rate is regulated within the range of from 1 to 30 °C/min.

11. (Original) The method of claim 1, wherein said hydrocarbon based material is at least one hydrocarbon selected from the group consisting of a saturated hydrocarbon, an unsaturated hydrocarbon, an aromatic hydrocarbon and a derivative thereof;

said reaction temperature maintaining the critical state of said carbon source is ranging from 200 to 800 °C;

said reaction pressure maintaining the critical state of carbon source is ranging from 1 to 400 atm;

said critical state equilibrating between liquid and gas phases is maintained for 1 min to 30 hrs;

said heating rate is regulated within the range of from 1 to 30 °C/min; and

said cooling rate is regulated within the range of from 1 to 30 °C/min.

**(IX) EVIDENCE APPENDIX**

None

**(X) RELATED PROCEEDINGS APPENDIX**

None

**CONCLUSION**

In view of the foregoing, it is respectfully submitted that the claims on appeal are patentable and that the rejection under 35 U.S.C. §103(a) should be reversed.

Respectfully submitted,

FROMMER LAWRENCE & HAUG LLP

Attorney for Appellants

By: /Howard C. Lee/

Ronald R. Santucci  
Reg. No. 28,988  
(212) 588-0800  
Fax (212) 588-0500

Howard C. Lee  
Reg. No. 48,104